

REMARKS

Applicants request favorable reconsideration and allowance of the subject application in view of the preceding amendments and the following remarks.

To place the subject application in better form, the specification has been amended to correct minor informalities. Also, the abstract has been amended to correct minor informalities. No new matter has been added by these changes.

Claims 1-27 are presented for consideration. Claims 1, 6, 10, 15, 19 and 24 are independent. Claims 28-31 have been canceled without prejudice or disclaimer. Claims 1, 6, 10, 15, 19 and 24 have been amended to clarify features of the subject invention. Support for these changes can be found in the original application, as filed. Therefore, no new matter has been added.

Applicants request favorable reconsideration and withdrawal of the objection and rejections set forth in the above-noted Office Action.

Claims 28-31 were objected to as being of improper dependent form for failing to further limit the subject matter of a previous claim. This objection is respectfully traversed. Nevertheless, claims 28-31 have been canceled herein, thus rendering this objection moot.

Turning now to the art rejections, claims 28-31 were rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 5,976,741 to Ziger et al. Claims 1-5, 10-14 and 19-23 were rejected under 35 U.S.C. § 103(a) as being unpatentable over the Ziger et al. patent in view of U.S. Patent No. 5,412,214 to Suzuki et al. Claims 6-9, 15-18 and 24-

27 were rejected under 35 U.S.C. § 103(a) as being unpatentable over the Ziger et al. patent in view of the Suzuki et al. patent and further in view of U.S. Patent No. 6,597,002 to Kondo. Applicants submit that the cited art, whether taken individually or in combination, does not teach or suggest many features of the present invention, as previously recited in claims 1-31. Therefore, these rejections are respectfully traversed. Nevertheless, Applicants submit that claims 1-27, as presented, amplify the distinctions between the present invention and the cited art.

In one aspect of Applicants' invention, independent claim 1 recites a projection exposure apparatus which uses a mask including plural columns of a mask pattern for repeated exposure to a member to form plural columns of an exposure pattern thereon. The apparatus further includes an illumination system which irradiates light to the mask, a projection system which projects the light from the mask onto the member, an exposure stage which moves the member and a mask stage which moves the mask. The apparatus includes a controller which controls light irradiation from the illumination system to the mask, driving of the exposure stage, and driving of the mask stage. The controller alternately performs the light irradiation and step driving of the exposure stage for moving the member by a movement amount equal to n times a pitch of the columns of the exposure pattern. The controller performs step driving of the mask stage for moving the mask by a movement amount equal to n times a pitch of the columns of the mask pattern in association with step driving of the exposure stage in an early phase and a later phase of the

repeated exposure, and n is a natural number smaller than the number of the columns of the mask pattern.

In another aspect of Applicants' invention, independent claim 6 recites a projection exposure apparatus which uses a mask including plural columns of a mask pattern for repeated exposure to a member to form plural columns of an exposure pattern thereon. The apparatus includes an illumination system which irradiates light to the mask, a projection system which projects the light from the illumination system onto the member and an exposure stage which moves the member. The apparatus further includes a light shielding member which shields light to prevent light projection onto the member from some of the plural columns of the mask pattern, a light shielding member stage which moves the light shielding member, and a controller which controls light irradiation from the illumination system to the mask, driving of the exposure stage, and driving of the light shielding member stage. The controller alternately performs the light irradiation and step driving of the exposure stage for moving the member by a movement amount equal to n times a pitch of the columns of the exposure pattern. The controller performs step driving of the light shielding member stage for moving the light shielding member by a movement amount corresponding to a pitch equal to n columns of the mask pattern in a light projection region on the member in association with step driving of the exposure stage in an early phase and a later phase of the repeated exposure, and n is a natural number smaller than the number of the columns of the mask pattern.

In still another aspect of Applicants' invention, independent claim 10 recites a method of projection exposure including a first step of preparing a mask including plural columns of a mask pattern for repeated exposure to a member to form columns of an exposure pattern thereon, and a second step of alternately performing light projection from the mask onto the member through light irradiation to the mask and step movement of the member for moving the member by a movement amount equal to n times a pitch of the columns of the exposure pattern. At the second step, the mask is moved in a step manner by a movement amount equal to n times a pitch of the columns of the mask pattern in association with the step movement of the member in an early phase and a later phase of the repeated exposure, and n is a natural number smaller than the number of the columns of the mask pattern.

In yet another aspect of Applicants' invention, independent claim 15 recites a method of projection exposure including a first step of preparing a mask including plural columns of a mask pattern for repeated exposure to a member to form plural columns of an exposure pattern thereon, and a second step of alternately performing light projection from the mask onto the member through light irradiation to the mask and step movement of the member for moving the member by a movement amount equal to n times a pitch of the columns of the exposure pattern. At the second step, a light shielding region is formed to prevent light projection onto the member from some of the plural columns of the mask pattern, and the light shielding region is moved in a step manner by a movement amount corresponding to a pitch equal to n columns of the mask pattern in a light projection region

on the member in association with step driving of the member in an early phase and a later phase of the repeated exposure, and n is a natural number smaller than the number of the columns of the mask pattern.

In another aspect of Applicants' invention, independent claim 19 recites a method of manufacturing an exposed member, including a first step of preparing a mask including plural columns of a mask pattern for repeated exposure to a member to form plural columns of an exposure pattern thereon, and a second step of alternately performing light projection from the mask onto the member through light irradiation to the mask and step movement of the member for moving the member by a movement amount equal to n times a pitch of the columns of the exposure pattern. At the second step, the mask is moved in a step manner by a movement amount equal to n times a pitch of the columns of the mask pattern in association with the step movement of the member in an early phase and a later phase of the repeated exposure, and n is a natural number smaller than the number of the columns of the mask pattern.

In still another aspect of Applicants' invention, independent claim 24 recites a method of manufacturing an exposed member, including a first step of preparing a mask including plural columns of a mask pattern for repeated exposure to a member to form plural columns of an exposure pattern thereon, and a second step of alternately performing light projection from the mask onto the member through light irradiation to the mask and step movement of the member for moving the member by a movement amount equal to n times a pitch of the columns of the exposure pattern. At the second step, a light shielding

region is formed to prevent light projection onto the member from some of the plural columns of the mask pattern, and the light shielding region is moved in a step manner by a movement amount corresponding to a pitch equal to n columns of the mask pattern in a light projection region on the member in association with step driving of the member in an early phase and a later phase of the repeated exposure, and n is a natural number smaller than the number of the columns of the mask pattern.

By such an arrangement, the controller of the projection exposure apparatus, for example, can alternately perform irradiation and step driving of an exposure stage for moving a member a movement equal to n times a pitch of columns of the exposure pattern. In this instance, n is a natural smaller than the number of the columns of the mask pattern. Moving the member by n times a pitch means that the portion on the member corresponding to the individual mask pattern of the mask is repeatedly exposed. Therefore, it is possible to ensure the continuity of the continuous pattern exposed on the member. Furthermore, in the configuration that performs step driving by n times a pitch, the dosage of exposure in an early phase and a later phase of the repeated exposure (for example, the exposure dosage at the ends of the total exposure region on the member) are different from others.

According to the present invention, the mask can be moved by n times a pitch of the columns of the mask pattern in association with step driving of the exposure stage in an early phase and a later phase. Therefore, the dosage of exposure in the early phase and the later phase can be as moderate as that of the others.

Applicants submit that the cited art does not teach or suggest such features of the present invention, as recited in the independent claims.

The Ziger et al. patent teaches a method of forming grating patterns, which includes a first process and a second process performed after the first process. In the first process, an individual grating pattern 24 (which has a dimension of 2 mm \times 2mm, that is, the first - exposed grating patterns) formed in a horizontal row and a vertical column in a region of a matrix 22, and, in the second process, shifting the mask 25 and performing the exposure, the second exposed grating patterns are formed. In this patent, the shifting amount of the mask 25 is one-half of the pitch defined by the mask. This is discussed in more detail in the Ziger et al. patent at column 4, lines 13-15.

On the other hand, in the present invention, the exposure stage can be driven so that the member moves by n times a pitch of the columns of the exposure pattern. Since n is a natural number smaller than the number of the columns of the mask pattern, the arrangement in the present invention is markedly different from that of the Ziger et al. patent. That is, the repeated exposure to the same pattern (the portion corresponding to the one column of the mask pattern in the present invention) and the wafer 20 is not taught or suggested by the Ziger et al. patent.

For the reasons noted above, Applicants submit that the Ziger et al. patent does not teach or suggest salient features of Applicants' present invention, as recited in the independent claims.

Applicants further submit that the remaining art cited does not cure the deficiencies noted above with respect to the Ziger et al. patent.

The Suzuki et al. patent teaches a projection exposure method and an apparatus with focus detection. The Kondo patent teaches a scanning exposure apparatus and a device manufacturing method. Applicants submit, however, that the Suzuki et al. patent and the Kondo patent merely teach structures of ordinary projection exposure apparatus. Applicants submit, therefore, that these patents do not teach or suggest the salient features of Applicants' present invention, as recited in the independent claims, which have been discussed above. Accordingly, Applicants further submit that the Suzuki et al. and Kondo patents add nothing to the teachings of the Ziger et al. patent that would render obvious Applicants' present invention, as recited in the independent claims.

For the foregoing reasons, Applicants submit that the present invention, as recited in independent claims 1, 6, 10, 15, 19 and 24, is patentably defined over the cited art, whether that art is taken individually or in combination.

Dependent claims 2-5, 7-9, 11-14, 16-18, 20-23 and 25-27 also should be deemed allowable, in their own right, for defining other patentable features of the present invention in addition to those recited in their respective independent claims. Further individual consideration of the dependent claims is requested.

Applicants further submit that the instant application is in condition for allowance. Favorable reconsideration, withdrawal of the objection and rejections set forth in the above-noted Office Action, and an early Notice of Allowance are requested.

Applicants' undersigned attorney may be reached in our Washington, D.C. office by telephone at (202) 530-1010. All correspondence should be directed to our address listed below.

Respectfully submitted,

A handwritten signature in black ink, appearing to read "Steven E. Warner", written over a horizontal line.

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